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Abstract:

The primary factors affecting rigid pavement surface deflection measurements and backcalculation results include the locations of loading plate (i.e., interior, edge, and corner of the slab), finite slab size, the effects of adjacent slabs and/or concrete shoulders, and the effect of thermal curling due to a linear temperature differential. Thus, this study not only strives to minimize the major deficiencies of the existing backcalculation procedures, but also performs comprehensive and in-depth investigations on the effects of load transfer efficiency and temperature curling on rigid pavement backcalculation. The ILLI-SLAB finite element program originally developed at the University of Illinois was used for the analysis due to its simplicity and less errors than any other available program. Both dense liquid and elastic solid foundation options were analyzed.

The effect of adjacent slabs will be treated as having shear load transfer only for both doweled and undoweled pavements due to the existing problems of dowel load transfer formulation of the ILLI-SLAB program. To allow the analysis of a curled slab resting on an elastic solid foundation, some proper corrections have been made and verified in the program code. Two additional dimensionless variables have been identified and verified for the effects of loading plus curling for elastic solid foundation using the principles of dimensional analysis. Many series of finite element factorial runs over a wide range of pavement designs have been carefully selected and conducted. Prediction models for deflection adjustment factors at different pavement conditions were developed using local regression techniques to more accurately estimate actual pavement responses.

A closed-form EK backcalculation program, which closely simulates the well-known ILLI-BACK program, was developed using FORTRAN PowerStation software package. Different backcalculation approaches have been proposed including the use of the most widely used AREA deflection basin concept and modified deflection ratio procedures. Continuous research effort is still underway to incorporate the proposed approaches into the existing user-friendly TKUBAK computer program to facilitate the analysis of more practical rigid pavement backcalculation problems.